BURIED TOPOGRAPHY AND ITS RELATION TO AN IMPORTANT AQUIFER IN FRANKLIN COUNTY, OHIO†

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In his search for underground reservoirs, the ground-water specialist often must seek clues to the occurrence of aquifers by looking for conditions which in the past were favorable for the deposition of permeable beds. In glaciated regions a study of the buried topography often can provide such clues, leading to the location of buried sand and gravel aquifers. A striking example of the relationship between buried topography and the occurrence of an important aquifer was revealed by an investigation of the ground-water resources of Franklin County, Ohio, made by the U. S. Geological Survey, in cooperation with the Division of Water, Ohio Department of Natural Resources. In eastern Franklin County a buried lowland, developed on beds of soft shale, is a repository for thick and extensive deposits of permeable sand and gravel. The sand and gravel were deposited by glacial meltwaters which were confined to the lowland by abutments formed by more resistant rocks on either side. These permeable deposits compose an aquifer of great potential importance to the Columbus metropolitan area.

The glacial deposits in Franklin County range in thickness from zero, in areas where the bedrock is exposed, to more than 250 feet in buried valleys. A map of the bedrock surface, based largely on records of wells, has revealed two principal erosional surfaces, having dissimilar drainage patterns, whose respective geomorphic stages reflect differences in the resistance of the rocks into which the preglacial streams cut their channels. These erosional surfaces coincide roughly with the western and eastern halves of the county and are developed, respectively, on carbonate rocks of Silurian and Devonian age and on shales of Devonian and Mississippian age (fig. 1).

The buried valleys that formerly drained the shale terrane in the eastern part of the county form a well-integrated dendritic system which drained southward. Prior to Pleistocene glaciation the main stem of this system probably joined the Teays Valley in central Pickaway County, some 10 miles south of Franklin County. The buried valleys in the western part of Franklin County, which were cut into more resistant limestone and dolomite, also drained southward to the Teays Valley. They are not, however, dendritic in pattern but have instead a parallel alinement, suggestive of a trellis drainage system such as might be expected to have developed along the strike of the rocks.

The shale terrane in eastern Franklin County was in the early mature stage of topographic development prior to Pleistocene glaciation. The buried valleys are U-shaped in cross section and the interstream areas, though fairly wide, are characterized mainly by slopes and valley sides. In contrast, the limestone valleys in the western part of the county are narrow and V-shaped, and the bedrock divides are flat and comparatively wide. These features are characteristic of late youth in topographic development. There can be little doubt that both the shale lowland and the limestone upland were subjected to the same cycle of events after the Franklin County area was last uplifted. The shales were lowered more than the limestone because they are softer; for the same reason, the streams that drained the lower land had advanced farther in the erosional cycle. Altitudes on the buried shale upland in Franklin County range generally from about 750 ft in the

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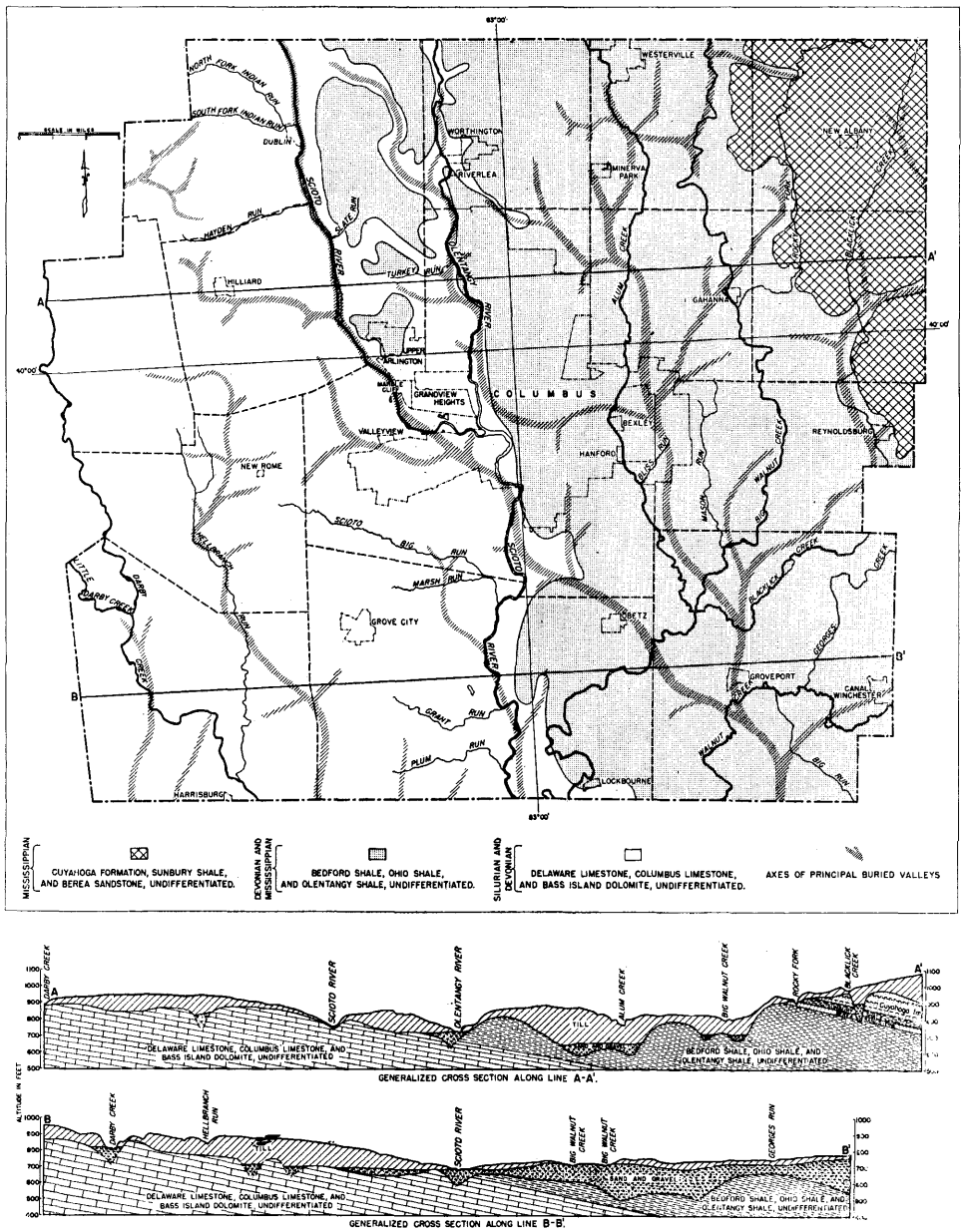

FIGURE 1. Map of Franklin County, Ohio, showing the distribution of the consolidated rocks and axes of the principal buried valleys and geologic cross sections.

south to 850 ft in the north; the altitude of the limestone surface west of the shale terrane ranges from 800 ft in the south to more than 900 ft in the north, and the altitude on the Mississippian rocks near the northeast corner of the county, bounding the shale terrane on the east, is a little more than 1,050 ft. The general level of the shale surface therefore is 50 to 100 ft lower than the limestone upland to the west and as much as 300 ft below the Mississippian rocks in the northeastern part of the county.

Thus, at the beginning of Pleistocene time, the shale terrane in eastern Franklin County stood well below the rocks on either side. This lowland had a profound influence on the distribution of the glacial deposits and, consequently, upon the ground-water resources of the county, for within this lowland were concentrated the meltwaters that poured from the wasting ice during periods of retreat of the glacial front. The meltwaters left extensive deposits of sand and gravel, locally more than 200 ft thick, which underlie at least 100 square miles in southeastern Franklin County and extend southward into adjoining Pickaway County. The sand and gravel deposits in most places represent an outwash plain, but they include areas of kames and eskers. Locally, the deposits are interbedded with thin layers of till. Goldthwait (1958, p. 212) states," . . . these buried esker, kame, and outwash forms surpass anything elsewhere in Ohio glacial drift."

Deposition of the sand and gravel probably began with the aggradation of the pre-Pleistocene valleys and the concentration of deposition at the junctions of the major tributaries. Continued deposition resulted from the spreading of debris-laden melt waters over this initial deposit. The outwash-plain deposits are generally covered by till, except in the valleys of the major streams where locally the till has been removed by postglacial erosion. In areas where the modern streams flow on the sand and gravel deposits, large ground water supplies can be pumped from wells located where they will induce stream infiltration. Ground-water supplies in the magnitude of several million gallons a day are available in the most favorable areas along the streams. Moreover, wells drilled in the buried outwash-plain deposits in areas away from the streams can yield large quantities of ground water from storage. Calculations show that a 12-in.-diameter well, screened in typical sand and gravel deposits that are 150 ft thick and are of large areal extent, can yield one million gallons of water a day (about 700 gallons a minute) for 10 years with a drawdown at the end of the period of only about 6 ft, assuming no recharge. It is clear that large quantities of ground water can be pumped from the outwash-plain deposits. Equally clear is the probability that these deposits will someday become an important source of water to the Columbus metropolitan area. Aquifers having a potential yield equal to that of the buried outwash-plain deposits in Franklin County are uncommon in Ohio. Future water requirements undoubtedly will make it imperative that all such large sources of ground water be located, evaluated, and eventually utilized. A study of the buried topography of the state can aid notably in this task and must be considered an integral part of any comprehensive water-resources investigation.

REFERENCES

Goldthwait, R. P. 1958. Wisconsin age forests in Ohio. I. Age and glacial events. Ohio Jour. Sci. 58: 209–219.